

Linnaeus' *Philosophia Botanica*

translated by Stephen Freer

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Carl Linnaeus was one of the towering figures of eighteenth century science, renowned as the father of binomial nomenclature and commemorated in the several Linnean Societies, including our own.

Apart from acknowledging his historical significance why would anyone today read Linnaeus in translation? I would argue that there is much to learn from such an exercise, not least because it should inspire humility – in many respects Linnaeus was the very model of a modern academic – and when it comes to pedagogy there has really been little change over the last two hundred and fifty years.

Although remembered today as a taxonomist, Linnaeus was a long standing teacher at the University of Uppsala where he attracted record audiences to his lectures. Students and former students remained important to Linnaeus' work – in this he was in marked contrast to Darwin who remained outside academia and worked alone. Daniel Solander, who accompanied Joseph Banks to Botany Bay, and who is remembered in Cape Solander and a memorial garden in the Royal Botanic Gardens, was a student of Linnaeus, but unlike his teacher was a reluctant publisher and did not himself describe the many Australian plants he collected.

Linnaeus had broad interests in what today we would call biodiversity, and was a pioneer in zoological systematics as well as in botany, but it is clear that his main fields of interest were botanical.

In 1736 Linnaeus had written *Fundamenta Botanica*, consisting of 365 aphorisms on matters botanical. *Philosophia Botanica* was published, in Stockholm and Amsterdam, in 1751. It consists of the 365 aphorisms of the *Fundamenta*, arranged in 12 chapters, but each aphorism is now followed by explanatory text.

In this translation 'Philosophia' is rendered as 'Science', as the 'Science of Botany' is the best explanation to a modern audience of the nature of

the book. (The modern concepts of science, and scientist, had yet to be developed by William Whewell – 'Scientia' translates as 'knowledge' which would not completely encompass the content of *Philosophia Botanica*).

The explanatory text which the *Philosophia* adds to the *Fundamenta* are essentially lecture notes – material which today, along with the illustrations, would be made available to students via the web. As lecture notes, they are in brief, almost staccato, point form, and provide opportunity for scathing attacks on the errors Linnaeus perceived in the work of others. This is the sort of thing that can be done to spice up lectures but would normally be absent from "serious" scientific writing. Indeed such flamboyance is absent in the much more serious *Species Plantarum*, the commencement of modern botanical nomenclature, published only two years later in 1753. There are also numerous references to, and examples from, Linnaeus's other publications. This frequent self-citation has been viewed as self-aggrandisement – not quite in good form – but if the *Philosophia* is seen as a set of lecture notes it is more understandable as being Linnaeus showing his students that he had runs on the board – his publication record showing that he was at what we would now call the cutting edge of research so that you could take what he said as being right. The self-citation was a means of attracting the interest of students rather than representing an ego trip by the author.

The *Philosophia* also includes memoranda – notes of practical instruction on matters such as preparing herbarium specimens and making notes on collections. These also show that, long before his time, Linnaeus included as advice to his students the appropriate Occupational Health and Safety warnings. ("Botanical outings are arranged differently by different people: with us, the following [arrangements] are usual.

Very light and very loose clothing, proper to botanists, (where circumstances permit) and the most appropriate for the business.....

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The clothing of the herborisant, beside linen, should be a short coat, very thin breeches extending from the hypochondria to the heels; smooth shoes, a hat with a very large brim, or else a sunshade, so that he turned by the way, the warmth, heat or sweat”.

When one looks at photographs of late nineteenth century botanists in Australia, dressed in heavy tweeds, it is clear that Linnaeus’ eminently sensible advice took a long time to become acceptable!

Even today, the basic structure of the *Philosophia* would provide a very good framework for an introductory botany course, starting with a historical review and introduction to the literature, before exploring a number of topics in detail.

Linnaeus accepted that species had been created, but he had a very good understanding of variation within species and was at great pains to stress that variants should not be elevated to the rank of species. A whole chapter (IX) is devoted to varieties, and the topic also arises elsewhere in the *Philosophia*. Linnaeus recognized (section 306) the practical need to recognize varieties.

“The use of varieties in gardening, cookery, and medicine makes it necessary to recognize them in ordinary life; otherwise, varieties do not concern botanists, except in so far as the botanists bother about them, so that the several species shall not be multiplied or confused”.

However, he contrasts the different taxonomic treatments in zoology and botany (section 259)

“In the animal kingdom, no sensible person would readily say that *varieties* are distinct species.

White, black, red, grey, and variegated cows; small and large, thin and fat, smooth and hairy cows; no one has said that there are so many distinct species.

Exresences, crowns of the head, and sutures of the skull have demonstrated that dogs, whether Melitean, spaniels, mastiffs, Greek, poodles, etc. are all of the one species”

and suggests that one of the reasons for the proliferation of species names by botanists was “Contagious madness among lovers of flowers”.

“*Definitions* that pass off varieties as species are erroneous” and as an “horrendous example” of this

bad practice Linnaeus conducts a demolition of Micheli’s treatment of *Trifolium* (the clovers).

Linnaeus had a surprisingly detailed understanding of the causes of variation within species, including light (sun versus shade), drainage (water logging versus dry), soil type and both disease and attack by insects. He advocated an experimental approach to studying variation (section 316. “Cultivation is the mother of very many varieties and is the best means of testing varieties”). It was a long time before such an approach became common place in what developed as a very observation based science.

Section 334 provides a remarkably succinct introduction to ecology and biogeography. In the discussion of variations in flora and vegetation in relation to latitude there are indications of the ideas subsequently developed by von Humbolt. The lengthy discussion of the relationship between species and habitats concludes with the observation that “So, by mere inspection of the plants, the earth and soil beneath can be discerned”, a concept which still underlies a great deal of ecological survey. The next section (335) provides an overview of phenology and demonstrates an understanding of the role of factors such as temperature and day length in determining features such as germination and flowering, although it was to be many years before physiologists elucidated the mechanisms involved.

Students today are always anxious that their courses contain material of practical value; it was obviously the same in the eighteenth century, and Linnaeus obliged, with a final chapter (XII), entitled “Potencies”, dealing with economic botany. Much of this material is still relevant, and with the emphasis on natural medicines would have renewed appeal today even though some of the claims still need to be rigorously tested. Nevertheless if Linnaeus was correct in his observation (section 341) that both tomatoes and eggplant were “Maddening and narcotic with our people” it could explain a great deal!

What does *Philosophia* tell us about the development of Linnaeus’ taxonomic ideas?

The binomial system of nomenclature is essentially complete and a great deal of the *Philosophia* involves laying down nomenclatural rules and guidance, although it has to be admitted that many of these rules were subsequently ignored or bent. (Section 236. “Generic names should not be misused to gain the favour, or preserve the memory, of saints, or of

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men famous in some other art. It is the only prize available to botanists; therefore it should not be misused” – to which one could add that it is also a prize to zoologists and palaeontologists).

The binomial system is one of Linnaeus’ greatest legacies. There are those who argue that it should be abandoned as the old hierarchical system of classification does not accord with modern understanding of the relationships between organisms derived from molecular studies, but for sheer practicality it is unlikely to be replaced (Defences of the binomial system are provided by, Wheeler (2004) and Knapp *et al* (2004)).

The *Philosophia* clearly explains Linnaeus’ belief that the basis of taxonomy should be a Natural System and illustrates his attempts to develop such a system, based on appropriate invariant characters (and rejecting classifications based on phenotypic variation) and in particular on floral characters (relevant to Linnaeus’ sexual system). The importance of natural systems of classification (which, it would now be understood as reflecting as far as possible phylogeny) was soon accepted by most biologists. Although Linnaeus’ approach to developing a natural system was subsequently overtaken by newer versions, it is remarkable how many of the taxa recognized by Linnaeus have stood the test of time.

Linnaeus’ chapters on floral structures and breeding systems in plants were major contributions to biological science (and the lectures on sex, with their colourful use of analogies, no doubt went down well with his student audience – again, some things never change). The chapter on sex (V) contains, among numerous other details, probably the first published data on the annual seed production of individual plants, and this could be said to be the pioneering work in plant demography – a field which did not develop for another two hundred years. I was struck by Linnaeus pointing out the occurrence of arils in a number of species. This feature of seeds of so many tropical species is found in a few European plants, but is not mentioned at all in many subsequent northern hemisphere textbooks.

Linnaeus explains clearly the definitions of many features – leaf shapes, floral structures etc – thus providing a consistent framework for all subsequent descriptive studies. The definitions, and illustrations, provide evidence of Linnaeus’ keen and careful eye for detail. This attention to detail is also seen in the distinction drawn between right and left handed

climbers, long before Flanders and Swann drew attention to the same phenomenon.

Although Linnaeus provides a broad overview of botany for his students it is clear that he expected that many of the examples he presents would have been familiar (for those more exotic species from foreign lands he provides a bit more detail). In this regard, Linnaeus, if put before a 21st century undergraduate audience, would find life a little harder. Although the modern student would be familiar with many topics unknown in the eighteenth century (biochemistry, genetics, computing) the broad natural history knowledge, and the ability to make detailed observations, is perhaps much less well developed (despite marvellous television documentaries, natural history has become more a spectator sport than a participatory one – as noted by Marren 2002).

The *Philosophia* concludes with the statement

“In natural science the elements of truth ought to be confirmed by observation”.

This is as true today as it was two hundred and fifty years ago.

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Paul Adam